Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

eserve
A99.9
764Un

May 1980

Genetic Gains From Mass Selection In Lodgepole Pine

G. E. Rehfeldt,[1] R. C. Hamilton,[2]
and S. P. Wells[1]

Lodgepole pine offers unique possibilities for tree improvement by mass selection. Juvenile growth is rapid, and sexual maturity is reached early. But most importantly, reproduction from serotinous cones after fire or timber harvest tends to be tremendously variable (fig. 1), dense (fig. 2), and of the same age. Individual trees (elite trees!) also express growth rates far above the average (fig. 3).

We explored the possible genetic gains from mass selection (selection of elite trees from a mass of reproduction) in three populations located on the Targhee National Forest near Ashton in southeast Idaho. As reflected by elevation, these populations represented contrasting environmental conditions (table 1). Our procedures involved: (1) verifying that both tall and short trees were the same age, (2) selecting elite trees, and (3) measuring the height of elite trees and the heights of trees within a 0.05-acre circle surrounding each elite tree. Mean height of elite trees represents the selected population; mean height of all trees represents the unselected population (table 1). We emphasize that no rigorous grading procedures were used to select elite trees; selected trees were not necessarily the tallest trees in each population,

---

[1] Research forester and forestry technician, respectively, located at Intermountain Station's Forestry Sciences Laboratory, Moscow, Idaho.

[2] USDA Forest Service, Region 4, Ogden, Utah.

USDA Forest Service Research Note INT-283

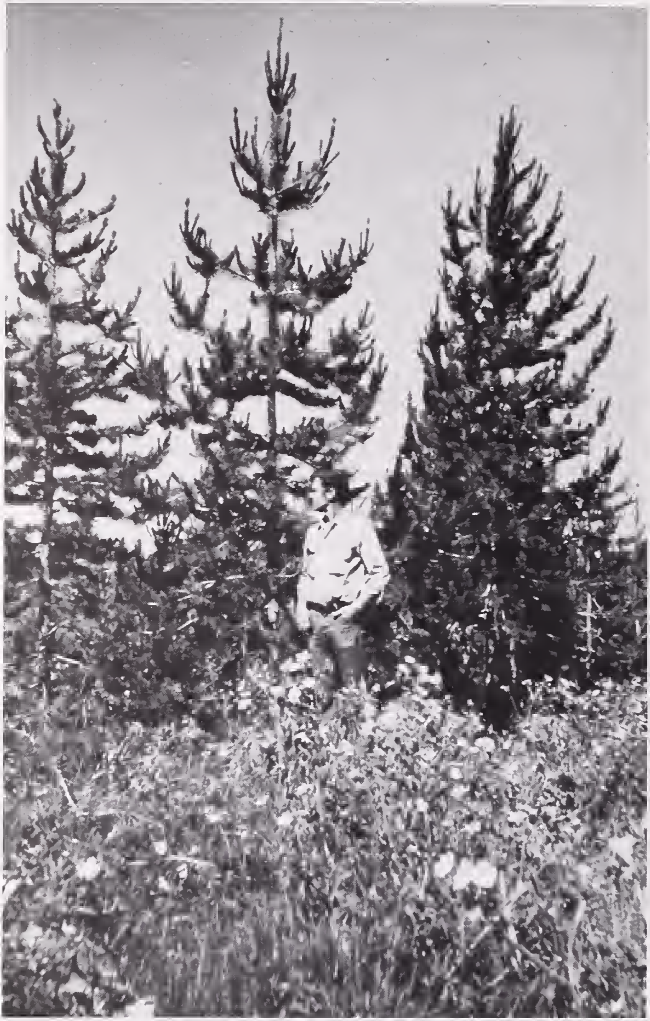

Figure 1.--Phenotypic variation in crown form and growth rate. Tree ages from left to right: 20, 17, and 18.

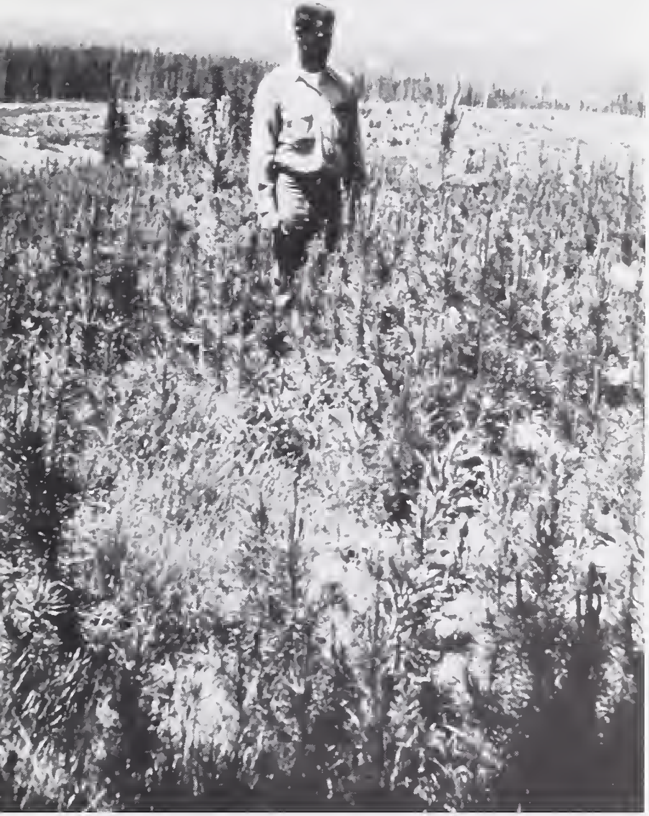

Figure 2.--Dense even-aged reproduction.

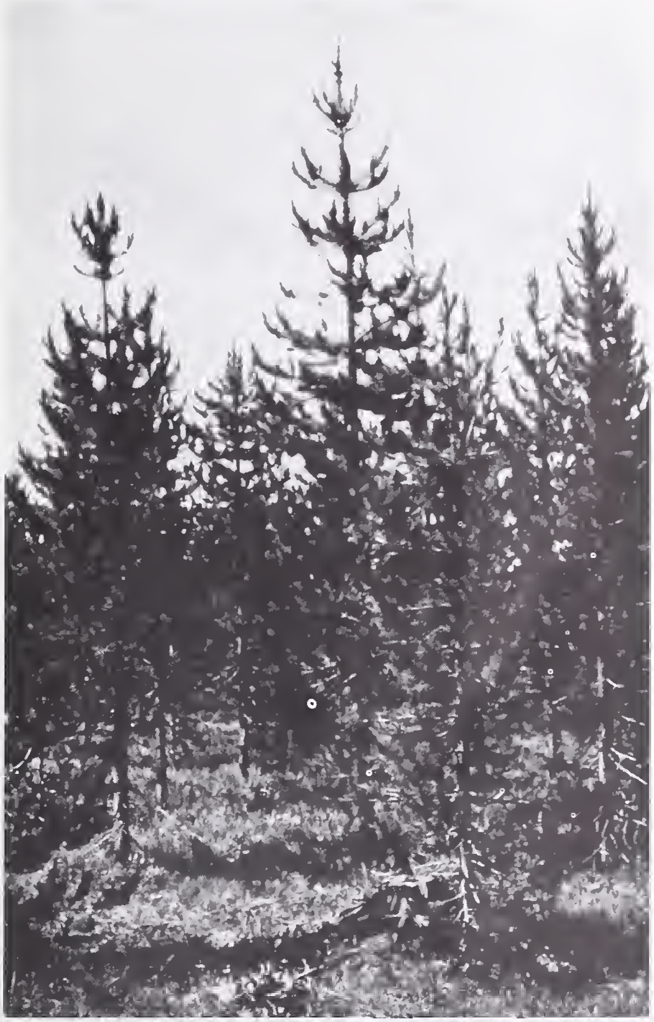

Figure 3.--Elite trees in natural reproduction.

Table 1.--*Characteristics of the populations sampled*

Characteristic	Locality Porcupine Creek	 Chick Creek	 Latham Springs
Elevation (feet)	5,700	6,600	7,400
Approximate area of of stand (acres)	75	50	150
Approximate area sampled (acres)	5	6	10
Trees per acre	2,960	2,093	3,228
Age of trees	11	14	13
Mean height of selected trees (feet)	11.7	17.7	10.2
Mean height of unselected trees (feet)	6.2	9.3	6.0

but they were those trees obviously taller than their neighbors within a relatively small proportion of the total population. In fact, we estimated that at least one elite tree occurred in each acre of the three populations.

If the elite trees interbreed, the genetic gain (ΔG) anticipated in their progenies is expressed:

$\Delta G = Sh^2$ where:

S = selection differential = mean difference between selected and unselected trees.

h^2 = heritability = the proportion of the phenotypic variance that is genetically additive.

From this relationship, percent gains can be estimated for a range of heritabilities (fig. 4). Thus, if heritabilities were as high as 0.5, seedlings derived from interbreeding selected trees from Chick Creek would be about 45 percent taller at age 14 than progenies produced by the unselected population; even in relatively cold environments (Latham Springs), gains of 33 percent could be anticipated. But most importantly, even if heritabilities are exceptionally low (0.1), gains of 7 to 11 percent could be expected in progenies of selected trees at ages 10 to 15.

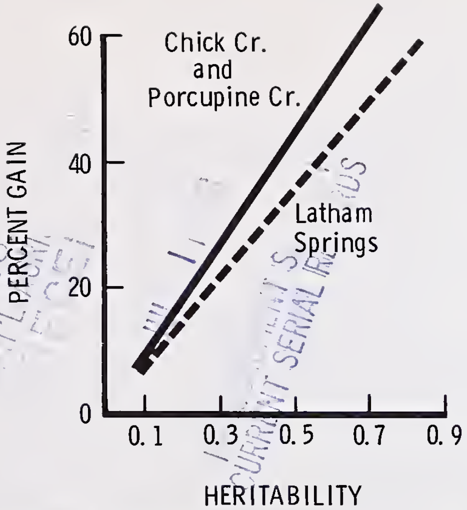

Figure 4.--Amount of genetic gain in height expected in progenies of elite trees for a range of heritabilities.

Even though heritabilities cannot be estimated without progeny tests, there is little doubt that substantial genetic gains can be made from mass selection in lodgepole pine. As shown by the relationship presented above, gains will accrue by maintaining a high selection differential in even-aged stands almost regardless of heritabilities. And, because of the young age at which lodgepole pine reaches sexual maturity, realization of gains is not too distant. All our selected trees were sexually mature. Grafted seed orchards could yield improved seeds within 5 years. Alternatively, seed orchards composed of progenies of selected trees would not only yield seeds in about 15 years, but would also yield extra increments of gain from family as well as individual tree selection. Regardless of the approach, mass selection will provide relatively inexpensive but efficient procedures for genetically improving the growth of lodgepole pine.

Intermountain Forest and
Range Experiment Station
U.S. Department of Agriculture,
Forest Service

☆ GPO: 1980—678-086